Knowledge Driven Preferences in Informal Inbound Open Innovation Modes

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Knowledge-Driven Preferences in Informal Inbound Open Innovation Modes: An Explorative View on Small to Medium Enterprises

Purpose – Through the lens of the open innovation model and knowledge-based view (KBV), the present research seeks to investigate three key factors (i.e. cognitive dimensions, the knowledge-driven approach and absorptive capacity) that are likely to determine the preference for informal inbound OI modes. The innovation literature has differentiated these collaborations into informal inbound open innovation (OI) entry modes and formal inbound OI modes, offering an advocative and conceptual view. However, empirical studies on these collaborations are still limited.

Design/methodology/approach – Building on the above theoretical framework, the empirical research was performed in two stages. First, data were collected via a closed-ended questionnaire distributed to all the participants from the sample by e-mail. Secondly, to assess the hypotheses structural equation modelling (SEM) via *IBM® SPSS® Amos 20* was applied.

Findings – The empirical research was conducted on 175 small to medium enterprises in the United Kingdom, suggesting that the knowledge-driven approach is the strongest determinant leading to a preference for informal inbound OI modes. The findings were obtained using structural equation modelling (SEM) and are discussed in line with the theoretical framework.

Research limitations/implications – Due to the chosen context and sector of the empirical analysis, the research results may lack generalisability. Hence, new studies are proposed.

Practical implications – The paper includes implications for the development of informal inbound open innovation led by knowledge-driven approach.

Originality/value – This paper offers an empirical research to investigate knowledge-driven preferences in informal inbound open innovation modes.

Keywords: knowledge-based view; open innovation model; SMEs, knowledge-driven approach; absorptive capacity; cognitive dimensions.

Article Type: Research paper

1.0 Introduction

Modern enterprises are constantly introducing innovations that are more incremental than radical (Schumpeter, 1934) by adopting a collaborative, open approach (Chesbrough, 2006). More and more enterprises have progressively been embedding the open innovation (OI) model within their organization (Díaz-Díaz and de Saá Pérez, 2014; Gassmann, 2010). In those firms incremental innovations are generated from the combination of external and internal knowledge, which allows enterprises to foster their performance by reducing their fixed and variable costs (Chesbrough,

2006; West and Bogers, 2014). Such a combination is a basic process of the OI model, which stimulates collaborative relations with the ecosystem (Brunswicker and Vanhaverbeke, 2015; Meissner and Shmatko, 2016; Santoro *et al*., 2016). In this way enterprises can engage in external collaborations through formal and informal linkages, which may or may not involve pecuniary and non-pecuniary activities (Dahlander and Gann, 2010; Sala, 2016; Wang *et al*., 2015). In fact, enterprises following an inbound OI strategy perform one or more of the following activities: co-research and development (co-R&D), mergers and acquisitions (M&A) or alliances, venture investments, licensing-in or knowledge or information sourcing from market-based and science-based actors (Cruz-Gonzalez *et al*., 2014; Gertner *et al*., 2011). Typically, these types of collaboration call for an internal effort supported by a solid and dynamic knowledge management system (Lichtenthaler and Lichtenthaler, 2009). The knowledge strengthens enterprises' ability to combine and absorb external knowledge with internal knowledge, evidencing that enterprises are now more focused on acquiring knowledge assets intensively (Grant, 2015; Nonaka, 1994).

Several scholars have differentiated the adoption of the OI model between small to medium enterprises (SMEs) and corporate enterprises (Mina *et al*., 2014; Mortara and Minshall, 2011; Nieto and Santamaría, 2010). Due to the scarcity of resources, SMEs are more eager to build efficient and durable relationships with their ecosystem to create innovation (e.g., Lu and Beamish, 2006; Matlay *et al*., 2006). The open innovation literature has addressed the influences of intangible resources (human, technological and knowledge) on SMEs' innovation performance (Hitt *et al*., 2012). In addition, intangible resources have been recognized as relevant assets in determining informal inbound relationships (Parida *et al*., 2009; Del Giudice *et al*., 2016).

There is an overall awareness of the benefits stemming from either informal or formal collaborations in adopting the OI model; nevertheless, studies on the effect – positive or negative – of these collaborations on the OI model through the lens of the knowledge-driven framework are as yet relatively scarce (Teece, 2007; Lichtenthaler and Lichtenthaler, 2009; Del Giudice and Maggioni, 2014). In turn, the OI literature has barely addressed how to manage internal knowledge to capitalize external flows of knowledge better (Vanhaverbeke and Cloodt, 2014).

Therefore, by recognizing the value of knowledge as a key intangible resource, the authors seek to integrate the knowledge-based view (Nonaka, 1994; Grant, 1996;) and the OI theory (Chesbrough, 2006) to suggest which enablers of the knowledge-driven perspective are important in capitalizing the formal and informal OI modes.

The paper contributes to the knowledge management and open innovation literature by assessing the relationship between open innovation and knowledge management in the ICT industry context,

highlighting the role of informal and formal inbound OI modes. A greater focus has been placed on labour enterprises (e.g. manufacturing), although some scholars have suggested the importance of openness to service and knowledge-intensive enterprises (e.g. ICT) (Chesbrough, 2011; Mina *et al*., 2014; Scuotto *et al*., 2016a). More specifically, the aim of the paper is to conduct an in-depth investigation of the role of the dynamics of SMEs' knowledge in determining the choice of establishing formal and informal inbound OI modes and the innovativeness of service enterprises. Accordingly, a quantitative, empirical analysis was conducted on a sample of 175 ICT enterprises in the United Kingdom using structural equation modelling (SEM).

This study is organized as follows. Paragraph 2.0 presents a theoretical focus on inbound OI modes and knowledge management. According to the theoretical framework, hypotheses are developed and tested within paragraph 3.0 using structural equation modelling (SEM). The findings are then discussed within paragraph 4.0, highlighting the research contributions to the innovation literature as well as to practitioners. In conclusion, the limitations of the study and further research are offered.

2.0 Theoretical Framework

Informal Inbound Open Innovation Modes versus Formal Inbound Open Innovation

Adopting the open innovation model, enterprises tend to build up collaborations intensively with actors of their ecosystem. Open and interactive collaborations generate a vibrant flow of external or internal knowledge (Chesbrough, 2003; Chesbrough and Bogers, 2014) within different contexts (Nieto and Santamaría, 2010; Mortara and Minshall, 2011; Bresciani *et al*., 2013; Mina *et al*., 2014). In line with this, the open innovation theory extends beyond the internal perspective proposed by the knowledge management literature, suggesting that "… firms can and should use external as well as internal ideas, and internal and external paths to market, as they look to advance their technology" (Chesbrough, 2004, p. 1). The phenomenon has been studied with respect to different sizes of enterprises and different types of industries (Bianchi *et al*., 2011). Nevertheless, service enterprises have received much less attention than enterprises from the manufacturing sector. In such a context, Chesbrough (2011) theoretically supported the benefit of open innovation for knowledge-intensive enterprises. Mina *et al*. (2014), through a statistical analysis, found that business service enterprises are more engaged in open innovation than manufacturing ones. Therefore, some evidence exists of an overall good open approach to innovation in knowledge-intensive industries (Parida *et al*., 2009; Malerba, 2010; McKelvey and Lassen, 2013; Hirsch-

Kreinsen and Schwinge, 2014; Audretsch *et al*., 2016; Del Giudice *et al*., 2016; Scuotto *et al*., 2016b).

According to the inbound OI model, enterprises can acquire external knowledge from different market-based partners, such as customers, suppliers and competitors, and/or science-based partners, such as universities and research centres (Carayannis *et al*., 1998; Santoro *et al*., 2016). The outbound OI model thus transfers knowledge and technology through selling or revealing activities (Lichtenthaler, 2009). Finally, the coupled process involves relying on both inbound and outbound activities with a cooperation process and networks with other enterprises (Chesbrough and Crowther, 2006). From the inbound perspective, so far scholars have used the concept of openness degree to explain the weight of collaborations in the innovation process (Laursen and Salter, 2006), whereas little attention has been paid to different open innovation practices and to the extent of the formality associated with them. Dahlander and Gann (2010) pointed out that enterprises can choose between pecuniary and non-pecuniary open innovation practices as well as sourcing or acquiring external knowledge and technologies. In the first case, enterprises acquire inventions and input to the innovative process, thus developing a more formal transaction. In the second case, enterprises source ideas and knowledge from customers, suppliers, competitors and consultants in a more informal manner. Subsequently, other scholars categorized inbound IO modes into formal modes, such as co-R&D, M&A and alliances, venture investments and licensing-in (Tennenhouse, 2004; Wang and Scuotto, 2014; Dyer *et al*., 2006; Santoro *et al*., 2016), and informal ones, such as sourcing knowledge from customers, suppliers and competitors and sharing facilities (Laursen and Salter, 2006; Piller and Walcher, 2006; Bellantuono *et al*., 2013; Mina *et al*., 2014).

Informal inbound OI is considered as the beginning approach to external actors to mitigate the risks related to innovation. For instance, enterprises are more willing to establish informal OI modes to reduce the information asymmetry. However, this mode does not strengthen the collaborations between actors. In turn, a formal OI mode tends to be applied to an SME's innovation process (Ahuja, 2000; Ferraris *et al*., 2016).

The integration of the different external partners through formal and informal inbound OI modes provides enterprises with a network-based innovation strategy that can improve innovation performance by developing synergies and diversifying risk (Bellantuono *et al*., 2013; Meissner and Kotsemir, 2016). In addition, the external network acts as market radar helping to identify emerging disruptive technologies that might threaten the incumbent enterprises (Chesbrough and Crowther, 2006). Thus, the implementation of OI modes enables firms to reduce their costs (van de Vrande *et al*., 2009), enter new markets (Hoffman *et al*., 2001) and earn higher profits than internally oriented

strategies (Chesbrough, 2006). In turn, increasing the number of external ties improves the innovation performance (e.g. Laursen and Salter, 2006). However, each OI mode releases different innovation outcomes (Parida *et al*., 2012). In particular, inbound OI involving suppliers and customers leads to incremental innovations, whereas cooperation with universities and research organizations enables radical innovations, pushes an enterprise towards the technological frontier and generates patents (Faems *et al*., 2005).

Some studies have further suggested that informal engagement is particularly relevant to service and ICT enterprises' innovation process and that they can benefit from a co-creation process with customers and suppliers (Chesbrough, 2011; Tether, 2005). In such a context, sourcing new knowledge from customers offers accurate and up-to-date information on their preferences and tends to aim to adapt the existing products to the needs of existing or new markets (von Hippel, 1988). Customers have accurate information on the market needs (von Hippel and Katz, 2002; Prahalad and Ramaswamy, 2004); thus, exchanges with them lower the likelihood of product failure and improve the overall customer satisfaction (Gruner and Homburg, 2000; Harrison and Waluszewski, 2008). However, they may block radical innovations (Gassmann *et al*., 2010) and they may not be able to specify their needs very precisely, let alone suggesting solutions to technical or other problems. Hence, tighter collaboration in the form of co-creation might be necessary with customers (Ulwick, 2002), but mere knowledge sourcing from customers may not be enough. Consequently, it is reasonable to infer that enterprises can benefit from both formal and informal inbound OI.

3.0 Study Hypotheses

The knowledge-driven approach is recognized as a necessary process in sustaining and maintaining competitive advantages in this knowledge-driven global economy, and knowledge is becoming even more important for service enterprises. However, the knowledge management literature is often limited to specific internal knowledge processes (Garett and Covin, 2015; Lichtenthaler and Lichtenthaler, 2009; Nonaka, 1994; Suzlanski, 2000), while a more integrative perspective, which considers both internal and external knowledge, is relatively under-investigated (Chesbrough, 2006; Grant and Baden-Fuller, 2004; Teece, 2007; Del Giudice and Maggioni, 2014). However, Teece (2007) showed that enterprises could combine internal and external knowledge to cope with the dynamic environment and to exploit technological and commercial opportunities. Lichtenthaler and Lichtenthaler (2009) further developed a framework for examining an enterprise's ability to manage knowledge in the open innovation context. In detail, considering knowledge exploration, retention

and exploitation inside and outside the organizational boundaries and relying on previous relevant studies, the authors suggested that enterprises have to develop inventive, absorptive, transformative, connective and innovative capacity to gain a competitive advantage through knowledge exploitation and exploration.

Theoretically, Vanhaverbeke and Cloodt (2014) suggested that the knowledge-based view of the firm is a valuable theoretical background for open innovation in which enterprises try to put the right internal and external resources in place to create new products and services. Therefore, the above authors indicated that the knowledge-based view of the firm focuses only on internal resources according to the closed innovation view.

All these efforts have thus offered a perspective based on the effectiveness of formal and informal OI modes depending on internal capabilities (Lichtenthaler and Lichtenthaler, 2009; Sisodiya *et al*., 2013), whereas external knowledge cannot be the only catalyst to increase enterprises' innovativeness (Voudouris *et al*., 2012; Ardito *et al*., 2015). One possible explanation is that an increase in knowledge flows inside and outside the firm can intensify the challenge related to knowledge management. Thus, developing a knowledge-driven approach is essential to capitalize innovation through formal and informal inbound OI modes, because new and valuable knowledge is created and converted into new products, services and processes by transforming a general idea into a more elaborated, technical and commercial business idea (Smith, 2001). Thus, developing internal knowledge capabilities through formal and informal practices helps in generating new ideas, in turn supporting the development of innovative capacity (Lichtenthaler and Lichtenthaler, 2009). Enterprises should ensure that knowledge is used effectively and efficiently through the development of internal mechanisms (Soto-Acosta & Cegarra-Navarro, 2016; Darroch and McNaughton, 2002). In effect, knowledge drives the creation of innovation via the combination of internal and external knowledge (Alavi and Leidner, 1999, 2001; Chesbrough, 2006; Díaz-Díaz and de Saá Pérez, 2014; Gassmann, 2010).

So far, the knowledge management literature has focused on the antecedents and process of knowledge (Alavi and Leidner, 2001; Nonaka, 1994). By integrating the resource-based view and the knowledge-based view of the firm, this study considers the role of both internal resources, such as human, technological and financial ones, and internal capabilities, such as absorptive capability, in facilitating several types of engagement with external stakeholders.

The first factor that can influence the effectiveness of knowledge is the cognitive dimension of the people within the organization, which is the mental model influenced by people's beliefs, values

and convictions (Nonaka and Takeuchi, 1995) as well as by loyalty, motivation and information asymmetry. Thus, it considers the knowledge possessed by people within the organization and an increase in the loyalty, motivation and information asymmetry as the key cognitive dimension, therefore enhancing the likelihood of engaging in both formal and informal OI ties (Hooley *et al*., 2005; Youndt *et al*., 1996). Even the most creative, knowledge-competent and innovative enterprises will fail if the actors do not employ loyalty, motivation and clear communication in their innovation process. These aspects are categorized as cognitive dimensions of an open innovation process of either formal or informal engagement. Therefore, in a formal inbound open innovation process, the role of the cognitive dimensions is essential in gathering the right skills, competences and motivation to co-operate in R&D with external entities, investing in profitable ventures and choosing profitable M&As or alliance operations and selecting the right technology or knowledge for licensing-in. Meanwhile, in an informal inbound open innovation process, effective human resource management seems to be the key driver to exploit and monitor the capacity for recognizing knowledge from customers, suppliers and competitors to improve enterprises' innovativeness (Andries and Czarnitzki, 2014; Del Giudice *et al*., 2016).

Valuable human and knowledge resources are wasted unless the management openly accepts and supports the efforts to gather, sort, transform, record and share knowledge (Sala *et al*., 2016; Soto-Acosta et al., 2016b). In fact, to make effective use of enterprises' knowledge, a network must be built up in which the knowledge and experience of the employees are available throughout the organization (Lichtenthaler and Lichtenthaler, 2009; Sisodiya *et al*., 2013). Thus, knowledge circulation is more important than the accumulation of data (Seufert *et al*., 1999), because it positively affects the knowledge recombination for applied innovation (Chesbrough, 2003; Chesbrough and Bogers, 2014; Mina *et al*., 2014; Mortara and Minshall, 2011; Nieto and Santamaría, 2010; Soto-Acosta et al., 2016b). Tacit, explicit and combinative knowledge circulation increases the likelihood of engaging in inbound OI modes. As a matter of fact, tacit knowledge has been defined as knowledge that is non-verbalized, intuitive and unarticulated (Polanyi, 1966), and it has often been regarded as an important basis for a competitive advantage from the resource-based view of the firm (Barney, 1991; Grant, 1996). In contrast, explicit knowledge can be coded and articulated, making it easier to transfer (Simonin, 1999). Considering the knowledge circulation across organizational boundaries, for example outbound OI strategies, it is reasonable to infer that it increases the likelihood of formally engaging in inbound OI modes due to the acquired legitimacy in the competitive environment (Suchman, 1995).

According to the knowledge-based view theory, the absorptive capacity (Cohen and Levinthal, 1990) is considered to be an enterprise's attitude towards perceiving and recognizing not just the

external knowledge that can be useful to create value but also the capability to assimilate, integrate and make it usable for the creation of both product and process innovation (Scuotto *et al*., 2016; West and Bogers, 2014). At first sight the role of absorptive capacity in formal inbound OI can appear less important than for informal inbound OI. In fact, initially the organization can develop innovative products and services with a lesser extent of absorptive capacity. In co-R&D, instead, the joint efforts with other organizations absorb knowledge from outside; thus, it is likely not to be essential. A similar situation occurs in the case of venture investments and M&A/alliances, in which the new co-operation is developing the new products or services. In turn, the absorptive capacity could be essential in the case of licensing-in, because, without the "right" internal knowledge, the firm cannot integrate the licensed-in technology or asset.

The absorptive capacity, therefore, is essential in informal inbound OI, because an enterprise can scan the external environment and then integrate the knowledge identified and acquired from customers, suppliers or competitors to improve its internal innovation capacity.

For these reasons, this study proposes the following:

H1(+). SMEs' cognitive dimensions lead to a preference for informal inbound OI modes rather than formal inbound OI modes.

H2(-). SMEs' knowledge-driven approach leads to a preference for formal inbound OI modes rather than informal inbound OI modes.

H3(+). SMEs' absorptive capacity leads to a preference for informal inbound OI modes rather than formal inbound OI modes.

4.0 Methodology

Research Context

With the growing percentage of innovation generated from small to medium enterprises (SMEs) in the United Kingdom, this empirical research focuses on a sample of SMEs from the high-tech sector. This country was recognized as being suitable for this research because SMEs account for in the region of 99.9% of the total enterprises in the UK, with an average annual turnover of £1.8 trillion (Federation of Small Businesses -FSB, 2015); SMEs are eager to take the opportunity from the market to generate innovations. Making strong and durable outbound relationships, SMEs generate new products or improve existing ones. Instead, corporate enterprises tend to gain benefits from local SMEs as they tend to adopt an outsourcing approach. Moreover, SMEs are more willing

to be flexible and adopt their internal organization to continual market changes (Del Giudice *et al*., 2016; Popa et al., 2016; Mina *et al*., 2014; Mortara and Minshall, 2011; Nieto and Santamaría, 2010). This is because SMEs are likely to be more innovation oriented (Martinez-Conesa et al., 2017; Keskin, 2006; Rhee *et al*., 2010; Rosenbusch *et al*., 2011; Salavou and Lioukas, 2003). In particular, SMEs in the ICT industry are more intensively active in innovating than those in other sectors (Chesbrough, 2011; Mina *et al*., 2014), because consumers are frequently calling for new technologies and in turn increasing the local and global competition (Audretsch *et al*., 2016; Del Giudice *et al*., 2016; Hirsch-Kreinsen and Schwinge, 2014; Malerba, 2010; McKelvey and Lassen, 2013; Parida *et al*., 2009; Scuotto *et al*., 2016b).

Research Design and Sample

Building on the above theoretical framework, the empirical research was performed in two stages. First, data were collected via a closed-ended questionnaire distributed to all the participants from the sample by e-mail. Secondly, to assess the hypotheses (e.g. Figure 1), structural equation modelling (SEM) via *IBM® SPSS® Amos 20* was applied.

Of the total number of 339 SMEs operating in the ICT industry in the United Kingdom, 175 SMEs were studied to determine whether there are positive relationships between the 4 aforementioned intangible assets: cognitive dimensions, knowledge-driven approach and absorptive capacity with the choice of adopting informal outbound open innovation modes (Table 1).

Table 1. Measures

Measures	***Definitions***	***References***
Cognitive dimensions	Cognitive dimensions are considered relevant in the process of creating new relationships with the external environment. Enterprises need to have a high level of loyalty as well as employees' motivation and a low level of asymmetric information.	Hooley *et al*. (2005); Nonaka and Takeuchi (1995); Youndt *et al*. (1996)
Knowledge-driven approach	Knowledge drives the creation of innovation via the combination of internal and external knowledge.	Audretsch *et al*. (2016); Hirsch-Kreinsen and Schwinge (2014); McKelvey and Lassen (2013); Malerba (2010); Parida *et al*. (2009); Smith (2001)
Absorptive capacity	Absorptive capacity is considered not only the firm's attitude towards perceiving and recognizing the external knowledge that can be useful to create value but also the capability to assimilate, integrate and make it usable for the creation of both	Cohen and Levinthal (1990); Scuotto *et al*. (2016); West and Bogers (2014)

	product and process innovation.	
Informal outbound open innovation modes	Informal engagement is particularly relevant to service and ICT enterprises' innovation process, and they can benefit from a co-creation process with customers and suppliers.	Alavi and Leidner (1999, 2001); Chesbrough (2006, 2011); Díaz-Díaz and de Saá Pérez (2014); Gassmann (2010); Tether (2005).

As shown by some previous research (Parida *et al*., 2012; Van de Vrande *et al*., 2009), the two key proxies for an open innovation model are a) progress in innovation in the past five years and b) established inbound and outbound relationships in the past five years. Therefore, the sample of SMEs was selected using the above two determinants.

All the SMEs were approached by e-mail first; if their e-mail address was not available, they were approached by phone. The sample selection took 4 months, and 175 SMEs were recognized as being suitable for this research. The participants were 93 R&D managers and 82 owners, chosen for their position at the highest level in the management process.

Moreover, to avoid response bias, the online questionnaire was tested by interviewing 5 R&D managers and 5 owners selected randomly from the sample (Chirico and Salvato, 2014).

Using the funnelique technique (Breiman *et al*., 1984), ancillary questions (e.g. gender, age, sector, number of employees and job position) were posed at the beginning of the questionnaire, followed by more specific questions based on the aforementioned measures (see Table 1). Each statement was answered by selecting a response from a range of five options stated on the five points of a Likert scale (Likert, 1932), that is, 1 as disagree strongly and 5 as agree strongly.

The data were collected over eight months, reported in a table and finally examined over three months. Overall, the empirical research lasted eleven months.

After the data collection, the data analysis was conducted on the basis of the five aforementioned measures (or latent variables): cognitive dimensions, knowledge-driven approach, absorptive capacity, formal inbound open innovation modes and formal inbound open innovation modes. Each latent variable was associated with three items (or manifest variables) (see Table 2).

Table 2. Measures (or Latent Variables) and Items (or Manifest Variables)

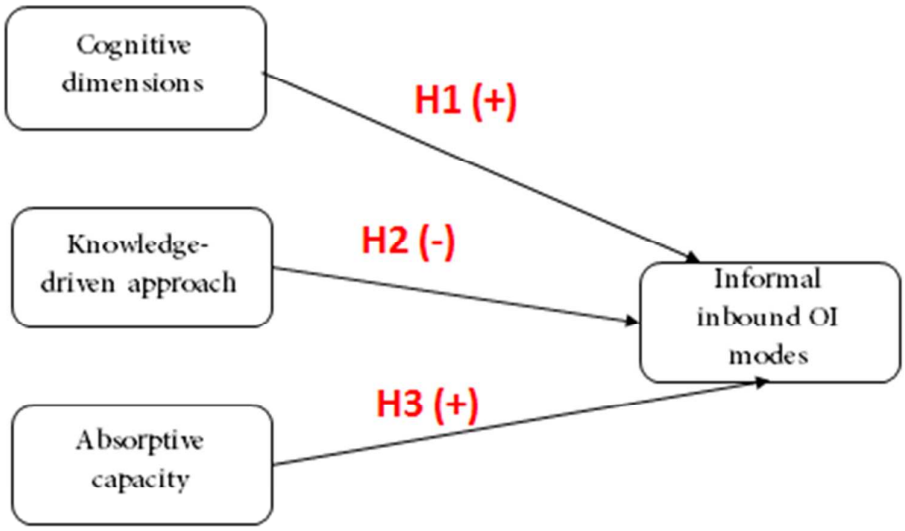
Dimensions	***Items***	***References***
Informal inbound OI	How much do you agree with the statement "your enterprise has established informal inbound modes (e.g. supplier involvement; competitor scanning; and sharing facilities) to develop innovation in the past five years"?	Alavi and Leidner (1999, 2001); Chesbrough (2006, 2011); Díaz-Díaz and de Saá Pérez (2014); Gassmann (2010); Tether (2005)

	How much do you agree with the statement "your enterprise has invested in informal inbound modes (e.g. supplier involvement; competitor scanning; and sharing facilities) to develop innovation in the past five years"?	
	How much do you agree with the statement "your enterprise has improved its internal innovation process via formal inbound modes (e.g. supplier involvement; competitor scanning; and sharing facilities) in the past five years"?	
Cognitive dimensions	How much do you agree with the statement "your enterprise is internally motivated to share information"?	Hooley *et al*. (2005); Nonaka and Takeuchi (1995); Youndt *et al*. (1996)
	How much do you agree with the statement "information asymmetry is a barrier to the informal inbound modes"?	
	How much do you agree with the statement "loyalty leads to the preference for formal inbound modes"?	
Knowledge-driven approach	How much do you agree with the statement "your enterprise has adopted a knowledge-driven approach"?	Audretsch *et al*. (2016); Hirsch-Kreinsen and Schwinge (2014); Malerba (2010); McKelvey and Lassen (2013); Parida *et al*. (2009); Smith (2001)
	How much do you agree with the statement "SMEs are innovative oriented"?	
	How much do you agree with the statement "your enterprise shares frequently relevant knowledge across all departments"?	
Absorptive capacity	How much do you agree with the statement "your enterprise is eager to convert external knowledge into an innovation"?	Cohen and Levinthal (1990); Scuotto *et al*. (2016); West and Bogers (2014)
	How much do you agree with the statement "your enterprise tends to exploit new technologies"?	
	How much do you agree with the statement "your enterprise tends to explore new technologies"?	

To the test the aforementioned hypotheses, the authors applied structural equation modelling using IBM® SPSS® Amos 20. Using this method, the foregoing hypotheses were assessed by referring to the research design model (Figure 1).

The suitability of this method has been stated by previous research thanks to SEM's ability to analyse a large sample, to explore a new study and to test the theory in the realm (Hair *et al*., 2011; Hooper *et al*., 2008; Sánchez *et al*., 2009).

Figure 1. The Design Model



5.0 Findings

It emerged that 85% of the participants were eager to establish informal inbound relationships with a particular focus on sharing facilities and customers' involvement in the innovation process. However, the test revealed that quite a large percentage of the participants recognized information asymmetry as a barrier to developing formal inbound relationships. Nevertheless, the intensive flow of knowledge – either tacit or explicit – stimulated SMEs to become increasingly oriented towards innovation adopting an open approach. Therefore, the test also showed a high percentage of participants (82%) who appeared to be particularly willing to share knowledge with their ecosystem. The remaining part assumed a neutral position (neither disagreed nor agreed) regarding sharing their tacit knowledge. Nevertheless, they agreed on creating informal/formal inbound relationships to improve their innovation performance.

Structural Equation Modelling via IBM SPSS Amos

Adopting structural equation modelling (SEM), the relationships between latent variables (e.g. measures) and manifest variables (items) were measured. The assessment analysis was divided into the outer model and the structural model.

Outer Model

The outer model was used to evaluate the relationships between the latent variables and each manifest variable (Chin and Newsted, 1999, p. 322). The manifest variables were considered as a "reflection" of their *latent variables* (Tenenhaus *et al*., 2010). The reliability of these relationships was estimated using Cronbach's alpha (Cronbach, 1951). The value is ≥0.7, which validates the model (Hair *et al*., 2010) (Table 3). Alongside this, the reliability was measured to evaluate the internal consistency. The result was also positive, showing a value of >0.3 (Henson, 2001).

Table 3. Reliability Test

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.81	.83	175

Structural Model

In the structural model, the relationships among all the latent variables were assessed via a path analysis and bootstrapping approach (Anderson and Gerbing, 1988; Chin, 1998). Therefore, to test the hypotheses, the values of the unstandardized coefficients, standardized coefficients, T-statistics and corresponding p-values were determined (see Table 4 and Figure 2).

H1(+) – SMEs' cognitive dimensions lead to a preference for informal inbound OI modes rather than formal inbound OI modes – was confirmed: the value of >2.0 validated this hypothesis (e.g. T=3.0, p<0.001). H2(+) – The knowledge-driven approach leads to a preference for formal inbound OI modes rather than informal inbound OI modes – was not confirmed, with a value of <2.0 (T=0.8, p<0.001). H2 thus was not validated. Finally, H3(+) – SMEs' absorptive capacity leads to a preference for informal inbound OI modes rather than formal inbound OI modes – was validated, supported by a positive relationship between absorptive capacity and informal inbound OI modes (e.g. T=5.3, p<0.001).

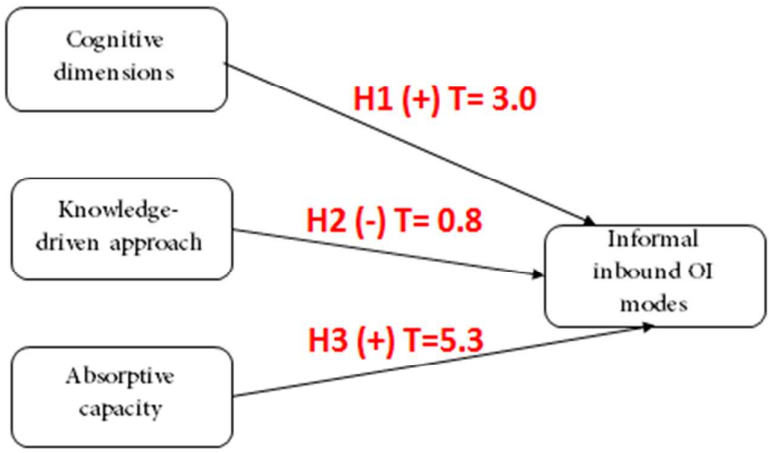
Table 4. Hypothesis Testing Results

Hypothesis	*Standardized regression coefficient*	*Standard error*	*Critical ratio*	*T-value*

H_1 (+)	Cognitive Dimensions→ Informal Inbound OI Modes	0.121	0.202	0.464	3.0
H_2 (+)	Knowledge-Driven Approach → Informal Inbound OI Modes	0.000	0.051	0.003	0.8
H_3 (+)	Absorptive Capacity → Informal Inbound OI Modes	0.309	0.074	2.599	5.3

Notes: *: The standardized regression coefficient is significant at the 0.001 level (two-tailed).**

Figure 2. Bootstrap Test of the Hypotheses



6.0 Discussion and Conclusion

The literature has agreed that opening the innovation boundaries is critical to cope with the current dynamic and competitive environment. This paper further extends the understanding of the internal knowledge management enablers that help in capitalizing both the formal and the informal inbound OI mode. In fact, the open innovation literature has scarcely addressed which knowledge practices and mechanisms increase the likelihood of engaging in different OI modes. Therefore, by recognizing the value of knowledge as a key intangible resource, this study aimed to integrate the knowledge-based view (Nonaka, 1994) and the OI theories (Chesbrough, 2003) to suggest which enablers of the knowledge-driven perspective are important in capitalizing the formal and informal OI modes. In this context the findings suggested that, for ICT SMEs, cognitive dimensions and absorptive capacity lead to a preference for informal inbound OI rather than formal inbound OI, except the knowledge-driven approach.

With its findings the research contributes to the literature in several ways. First, the results showed that increasing the quality and the quantity of internal knowledge management mechanisms helps to

explore and to exploit external knowledge. Second, the findings indicated that cognitive dimensions and absorptive capacity lead to the establishment of informal ties with external partners, while the knowledge-driven approach increases the likelihood of establishing formal ties. Third, the study suggested that a separation between informal and formal inbound OI modes has to be made to explore the different source patterns (Dahlander and Gann, 2010). In fact, from a knowledge-based view theory, different OI modes generate different internal tensions that should be managed with different internal knowledge management mechanisms (Ahn *et al.*, 2016). Finally, the present research reconceptualized the knowledge management construct by including several aspects related to the cognitive dimension, the knowledge circulation within and across the organization and the absorptive capacity.

This paper also has several managerial implications. First, by developing different internal knowledge management mechanisms, enterprises can engage in diverse inbound OI modes. In particular, the research showed that each dimension of knowledge management capacity is useful to engage in informal and formal OI modes (Vrontis *et al.*, 2016). In this case enterprises aiming to develop disruptive technologies or engage in steady new service development should invest in internal knowledge management mechanisms. Second, the results showed that enterprises should adopt an OI strategy based on internal mechanisms. In fact, the study found that informal inbound OI modes are likely to provide benefits when service SMEs are willing to circulate knowledge within and across the organizational boundaries. One possible explanation is that, when enterprises allow the outflow of knowledge, they achieve legitimacy in the business environment, therefore increasing the likelihood of finding strategic partners (Suchman, 1995). In turn, by increasing their cognitive dimensions and absorptive capacity, ICT SMEs are able to establish informal ties with customers, suppliers and competitors. On one side, loyalty, motivation and an absence of information asymmetry promote the employees' willingness to share their visions and search for knowledge and solutions from value chain actors. On the other side, a proactive approach to recognizing, assimilating and implementing external knowledge is useful when engaging in OI, especially through informal ties.

This study of course has its limitations. First, it did not check the effectiveness of OI, so it could not evaluate the effects of the formal and informal inbound OI modes of innovation/financial outcomes. Future research may focus on the effect of the formal and informal OI modes to evaluate and check for moderating effects of the internal knowledge management mechanisms. Second, the paper investigated the relationship between internal knowledge management mechanisms and several inbound OI modes. However, this relationship could be affected by the individual industries' characteristics. In fact, this study focused on service SMEs, which are traditionally more open,

given that they need to share information and knowledge in their day-to-day business activities, while the outcomes of the research could be different in a manufacturing context. Future studies may investigate this relationship in other contexts as well. Moreover, due to the unexpected result regarding the knowledge-driven approach, which resulted in it leading to a preference for the informal inbound OI modes, the authors deem that a qualitative study might be useful to gain a deeper understanding of this occurrence.

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